This document contains Part 2 (pp.136–143) of Chapter 5 of the National Coastal Condition Report III.

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National Coastal Condition Report III

Chapter 5: Gulf Coast Coastal Condition

Part 2 of 3

December 2008

Water Quality Index

Based on the 2001 and 2002 NCA survey results, the water quality index for the coastal waters of the Gulf Coast region is rated fair, with 14% of the coastal area rated poor and 49% of the area rated fair for water quality condition (Figure 5-4). The water quality index was developed based on measurements of five component indicators: DIN, DIP, chlorophyll *a*, water clarity, and dissolved oxygen. Estuaries with poor water quality conditions were found in all five states, but the contributing factors differed among states. At stations in Texas, Louisiana, and Mississippi, poor water clarity and high DIP concentrations contributed to poor water quality ratings, whereas poor conditions at stations in several Texas bays were also due to high chlorophyll *a* concentrations. Only three sites in Louisiana had high concentrations of both DIN and DIP. Many of the stations rated poor or fair for the various component indicators did not overlap, resulting in a lower percentage of Gulf Coast coastal area rated good for the water quality index than for any of its component indicators (see Chapter 1 for more information). This water quality index can be compared to the results of NOAA's Estuarine Eutrophication Survey (Brickler et al., 1999), which rated the Gulf Coast as poor for eutrophic condition, with an estimated 38% of the coastal area having a high expression of eutrophication.

Nutrients: Nitrogen and Phosphorus

The Gulf Coast region is rated good for DIN concentrations, but rated fair for DIP concentrations. It should be noted that different criteria for DIN and DIP concentrations were applied in Florida Bay than in other areas of the Gulf Coast region because Florida Bay is considered a tropical estuary. DIN concentrations were rated poor in 1% of the Gulf Coast coastal area, representing three sites in Louisiana's East Bay, Atchafalaya Bay, and the Intracoastal Waterway between Houma and New Orleans, LA. Elevated DIN concentrations are not expected to occur during the summer in Gulf Coast waters because freshwater input is usually lower and dissolved nutrients are used more rapidly by phytoplankton during this season. DIP concentrations were rated poor in 22% of the Gulf Coast coastal area, which included sites in Tampa Bay and Charlotte Harbor, FL, where high DIP concentrations occur naturally due to geological formations of phosphate rock in the watersheds and artificially due to significant anthropogenic sources of DIP.

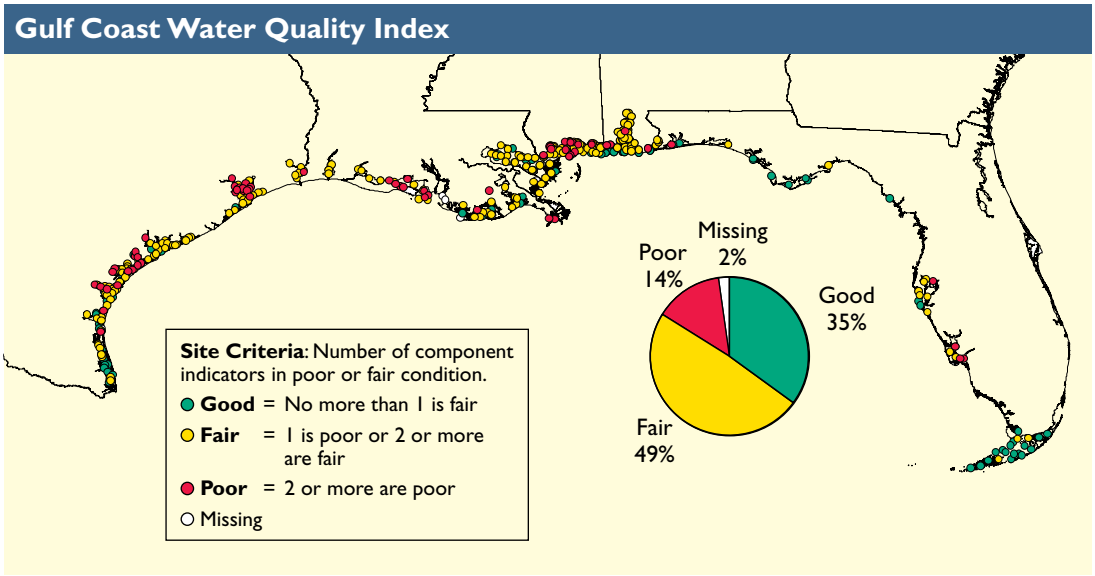


Figure 5-4. Water quality index data for Gulf Coast coastal waters (U.S. EPA/NCA).

Potential for Misinterpretation of Conditions for States with Smaller Coastlines

Alabama and Mississippi resource agencies are concerned that the figures presented in the Coastal Monitoring Data section of this chapter could potentially represent their estuaries unfairly. Both states have at least fifty locations that were sampled in the NCA 2001–2002 survey; however, because of the high density of these sites and the small area of estuarine resources of these states, even one or two sites rated poor (red circles) give the appearance of poor condition dominating a large portion of the entire coast of these states. Although showing the entire Gulf Coast region in a single graphic is consistent with the goals of this report, these displays do not provide a detailed view of all data, particularly for Alabama, Mississippi, and eastern Louisiana.

Chlorophyll a

The Gulf Coast region is rated fair for chlorophyll *a* concentrations, with 7% of the coastal area rated poor and 45% of the area rated fair for this component indicator. It should be noted that chlorophyll *a* concentrations were rated differently in Florida Bay than in other areas of the region because Florida Bay is considered a tropical estuary. High concentrations of chlorophyll *a* occurred in the coastal areas of all five Gulf Coast states.

Water Clarity

Water clarity in the Gulf Coast region is rated fair, with 22% of the coastal area rated poor for this component indicator. Lower-than-expected water clarity occurred throughout the Gulf Coast region, with poor conditions concentrated at stations in Mississippi, the Coastal Bend region of Texas, and Louisiana. The criteria used to assign water clarity ratings varied across Gulf Coast coastal waters (Figure 5-5) based on natural variations in turbidity levels, regional expectations for light penetration related to SAV distribution, and local waterbody management goals (see text box).

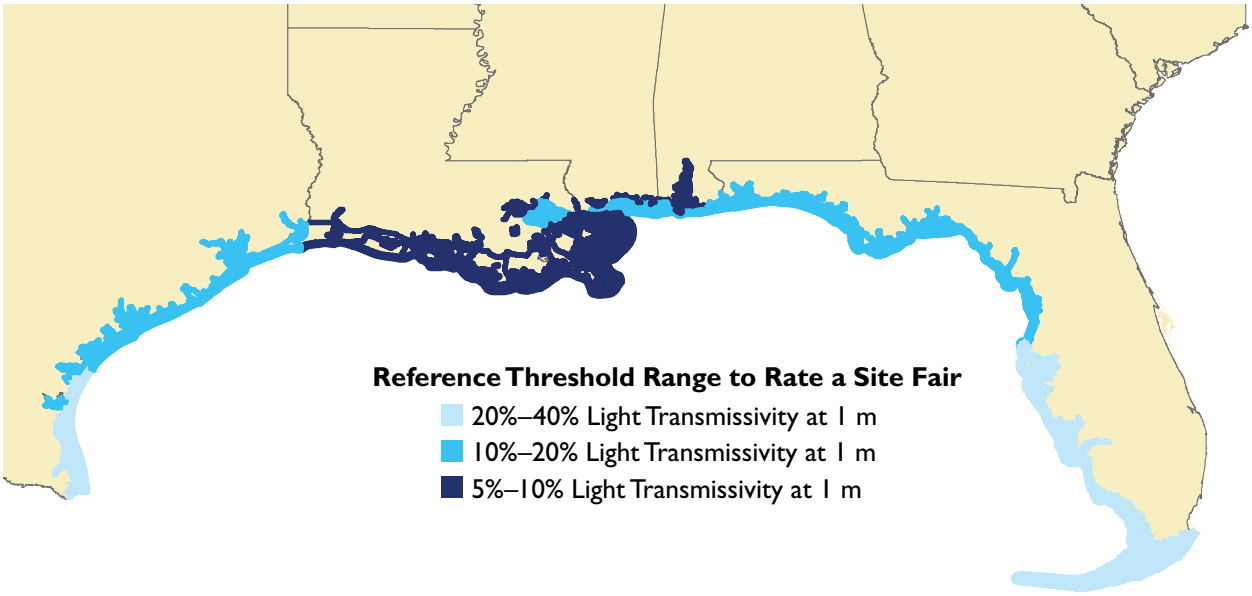


Figure 5-5. Map of water clarity criteria used in Gulf Coast coastal waters to rate a site fair (U.S. EPA/NCA).

Although the current NCA approach used to assess water clarity is an improvement over the previous effort, it still may reach inappropriate conclusions regarding water clarity for parts of the Gulf Coast region. Many of the areas of the Gulf Coast region have naturally high silt and suspended sediment loads. To modify the water clarity approach for this natural condition, researchers adjusted the approach by the "expected" water clarity levels to lower levels for much of the Gulf Coast region. Although this adjustment appears to have been successful for much of the Florida, Alabama, Mississippi, and Louisiana coasts, further adjustments may be necessary for Mississippi Sound and the Texas coast.

Dissolved Oxygen

The Gulf Coast region is rated fair for dissolved oxygen concentrations, with 5% of the coastal area rated poor for this component indicator. Hypoxia in Gulf Coast waters generally results from stratification, eutrophication, or a combination of these two conditions. Mobile Bay, AL, experiences regular hypoxic events during the summer that often culminate in "jubilees" (i.e., when fish and crabs try to escape hypoxia by migrating to the edges of a waterbody); however, the occurrence of jubilees in Mobile Bay has been recorded since colonial times, and these occurrences are most likely natural events for this waterbody (May, 1973).

Although hypoxia is a relatively local occurrence in Gulf Coast coastal waters, the occurrence of hypoxia in the Gulf Coast shelf waters is much more significant. The Gulf of Mexico hypoxic zone is the second-largest area of oxygen-depleted waters in the world (Rabalais et al., 2002). This zone, which occurs in waters on the Louisiana shelf to the west of the Mississippi River Delta, was not assessed by the NCA survey. From 1985 to 1992, the areal extent of bottom-water hypoxia in the zone during mid-summer averaged 3,000 mi^2, and the average area doubled to 6,500 mi^2 between 1993 and 1997 (Rabalais et al., 1999). In the summer of 2000, the area of the Gulf of Mexico hypoxic zone was reduced to 1,700 mi^2, following severe drought conditions in the Mississippi River watershed; however, by 2002, the hypoxic zone had again increased in size to 8,500 mi^2 (Figure 5-6). Current hypotheses speculate that the hypoxic zone results from water column stratification that is driven by weather and river flow, as well as from the decomposition of organic matter in bottom waters (Rabalais et al., 2002). River-borne organic matter, along with nutrients that fuel phytoplankton growth in the Gulf waters, enter the Gulf of Mexico from the Mississippi River. Annual variability in the area of the hypoxic zone has been related to the flows of the Mississippi and Atchafalaya rivers and, by

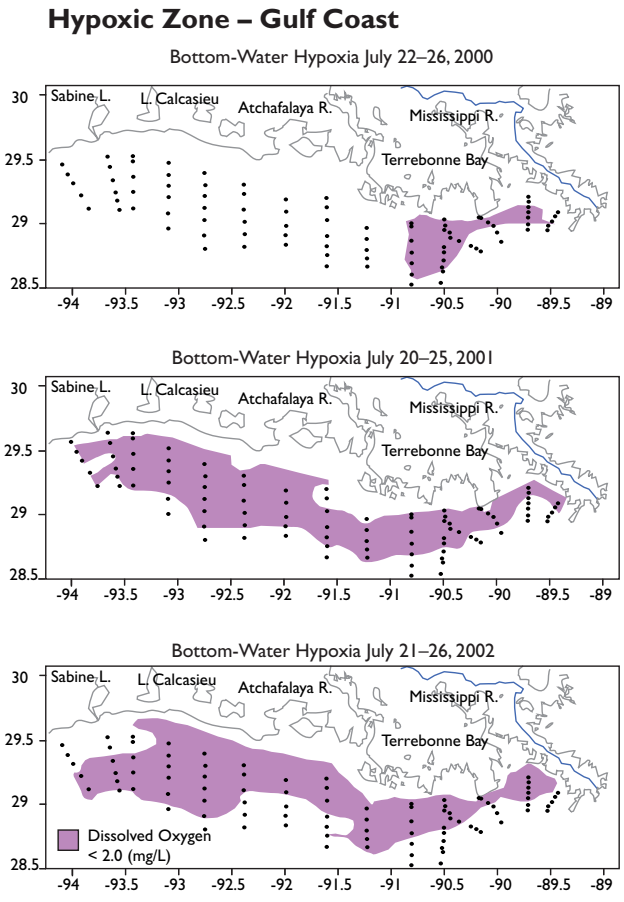
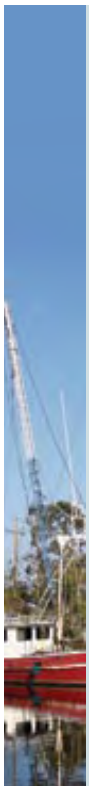


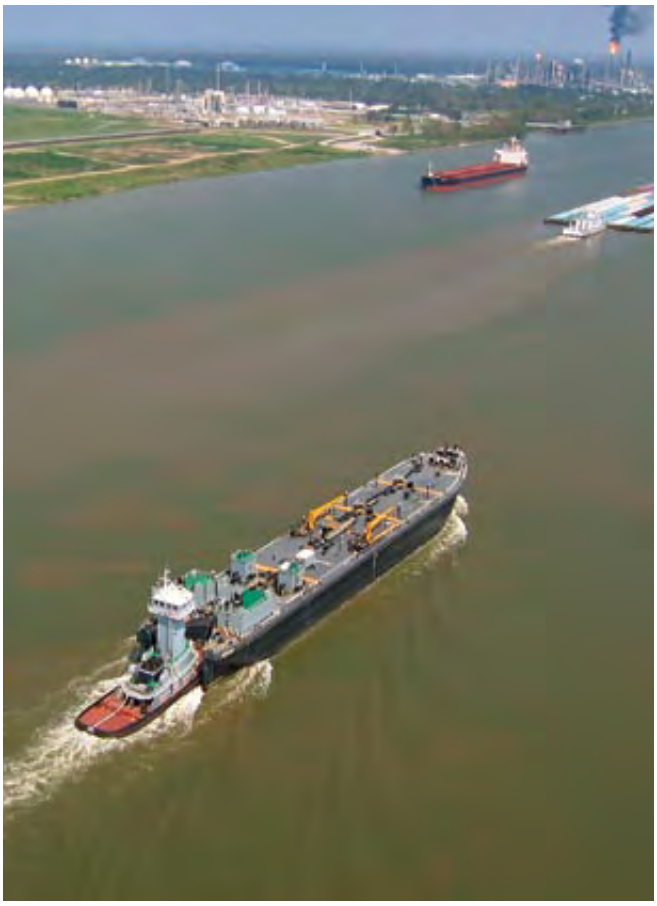
Figure 5-6. Spatial extent of the Gulf Coast hypoxic zone during July 2000, 2001, and 2002 (U.S. EPA/NCA, based on data provided by N. Rabalais, 2003).



The guideline used in the NCA analysis for poor dissolved oxygen condition is a value below 2 mg/L in bottom waters. The majority of coastal states either use a different criterion, ranging from an average of 4 to 5 mg/L throughout the water column to a specific concentration (usually 4 or 5 mg/L) at mid-water, or include a frequency or duration of time that the low dissolved oxygen concentration must occur (e.g., 20% of observed values). The NCA chose to use 2 mg/L in bottom waters because this level is clearly indicative of potential harm to estuarine organisms. Because so many state agencies use higher concentrations, the NCA evaluated the proportion of waters that have dissolved oxygen concentrations between 5 and 2 mg/L in bottom waters as being in fair condition (i.e., threatened).

extension, to the precipitation levels that influence these flows. Sediment cores from the hypoxic zone show that algal production in the Gulf of Mexico shelf was significantly lower during the first half of the twentieth century, suggesting that anthropogenic changes to the basin and its discharges have resulted in the increased hypoxia (CENR, 2000).

Between 1980 and 1996, the Mississippi-Atchafalaya River Basin discharged an annual average of 952,700 t of nitrogen as nitrate and 41,770 t of phosphorus as orthophosphate to the Gulf of Mexico (Goolsby et al., 1999). The nitrate load, which constitutes the bulk of the total nitrogen load from the Mississippi River basin to the Gulf of Mexico, has increased 300% since 1970 (Goolsby et al., 2001). Non-point sources, particularly from the agricultural areas north of the confluence of the Ohio and Mississippi rivers, contribute most of the nitrogen and phosphorus loads to the Gulf of Mexico (Goolsby et al.,1999). The potential importance of phosphorus limitation in the eastern portion of the hypoxic zone has led EPA to call for reductions in both nitrogen and phosphorus loads from the Mississippi-Atchafalaya River Basin.



Freshwater flows and nutrient loads from the Mississippi River are related to the extent of the hypoxic zone Gulf Coast shelf waters (courtesy of Lieut. Commander Mark Moran, NOAA).

Estimates of hypoxia for the Gulf of Mexico shelf have not been included in the NCA estimates of hypoxia for Gulf Coast coastal waters; consequently, the good rating for dissolved oxygen concentrations in the Gulf Coast region provided in this report should not be considered indicative of offshore conditions.

Sediment Quality Index

The sediment quality index for the coastal waters of the Gulf Coast region is rated poor, with 18% of the coastal area rated poor for sediment quality condition (Figure 5-7). The sediment quality index was calculated based on measurements of three component indicators: sediment toxicity, sediment contaminants, and sediment TOC.

Sediment Toxicity

The Gulf Coast region is rated poor for sediment toxicity, with 13% of the coastal area rated poor for this component indicator. Previous bioeffects surveys by NOAA (Long et al., 1996) and the results reported in the NCCR II (U.S. EPA, 2004a) showed less than 1% toxicity in large estuaries of the Gulf Coast region. Sediment toxicity is commonly associated with high concentrations of metals or organic chemicals with known toxic effects on benthic organisms; however, nine sites in Florida Bay were rated poor for sediment toxicity in the absence of high contaminant concentrations. The toxicity at these sites may have been caused by naturally high levels of hydrogen sulfide in the Bay's organic carbonate sediments, rather than by anthropogenic contamination (G. McRae, Florida Fish & Wildlife Research Institute, personal communication, 2006).

Sediment Contaminants

The sediment contaminants component indicator for the Gulf Coast region is rated good, with 2% of the coastal area rated poor for this component indicator. In addition, 1% of the coastal area was rated fair, primarily due to sites located in Alabama and in Pensacola Bay, FL. The sediment contaminants measured in Gulf Coast waters included elevated levels of metals, pesticides, PCB, and, occasionally, PAHs.

Sediment TOC

The Gulf Coast region is rated good for sediment TOC, with 14% of the coastal area rated fair for this component indicator and only 4% of the area rated poor.

Benthic Index

The condition of benthic communities in Gulf Coast coastal waters is rated poor, with 45% of the coastal area rated poor for benthic condition (Figure 5-8). This assessment is based on the Gulf Coast Benthic Index (Engle and Summers, 1999), which integrates measures of diversity and populations of indicator species to distinguish between degraded and reference benthic communities. Most Gulf Coast estuaries showed some level of benthic degradation.

Coastal Habitat Index

The coastal habitat index for the coastal waters of the Gulf Coast region is rated poor. The Gulf Coast region experienced a loss of 7,750 acres of coastal wetlands from 1990 to 2000, and the long-term,

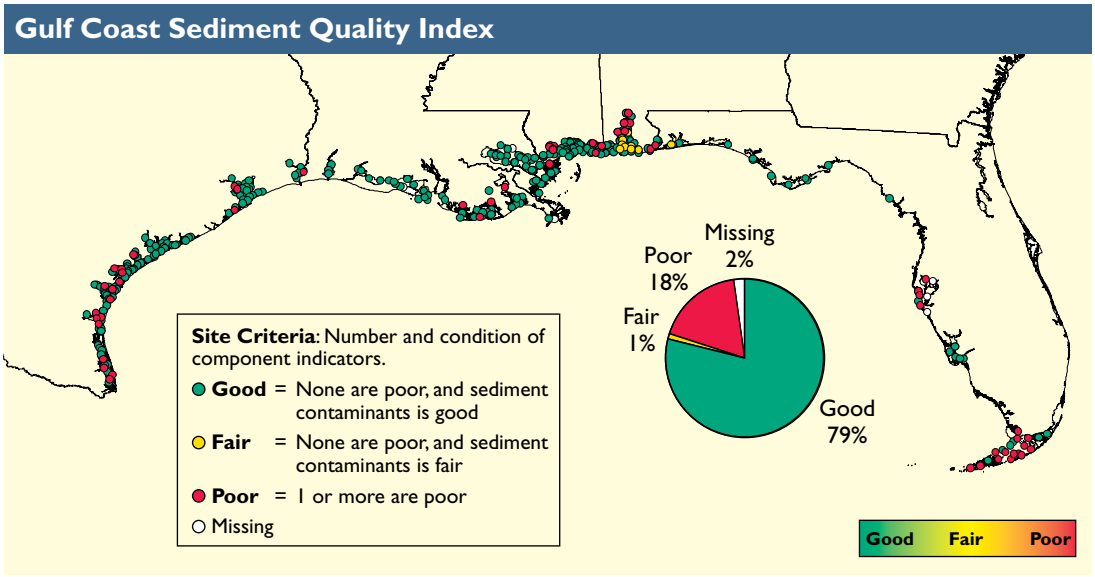


Figure 5-7. Sediment quality index data for Gulf Coast coastal waters (U.S. EPA/NCA).

average decadal coastal wetlands loss rate is 0.21%. Coastal wetlands in the Gulf Coast region constitute 66% of the total estuarine wetland acreage in the conterminous 48 states (Dahl, 2003). Although the Gulf Coast region sustained the largest net loss of coastal wetland acreage during the past decade compared with other regions of the country, the region also has the greatest total acreage of coastal wetlands (3,769,370 acres). Coastal development, sea-level rise, subsidence, and interference with normal erosional/depositional processes contribute to wetland losses along the Gulf Coast.

Fish Tissue Contaminants Index

The fish tissue contaminants index for the coastal waters of the Gulf Coast region is rated good, with 8% of all sites sampled where fish were caught rated poor for fish tissue contaminant concentrations (Figure 5-9). Contaminant concentrations exceeding EPA Advisory Guidance values in Gulf Coast samples were observed primarily in Atlantic croaker, catfish, and pinfish. Commonly observed contaminants included total PAHs, PCBs, DDT, mercury, and arsenic.

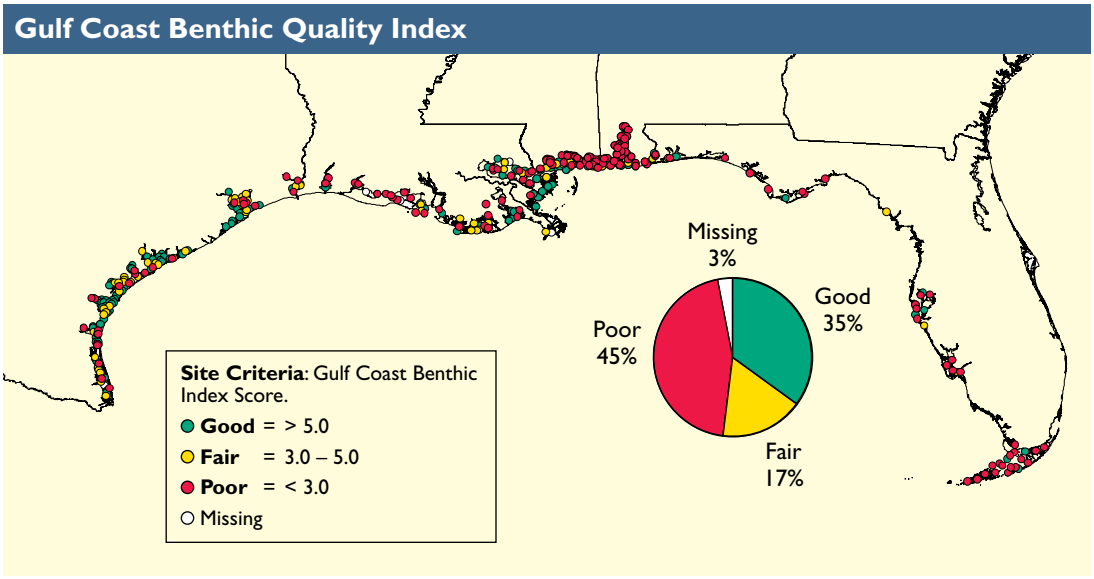


Figure 5-8. Benthic index data for Gulf Coast coastal waters (U.S. EPA/NCA).

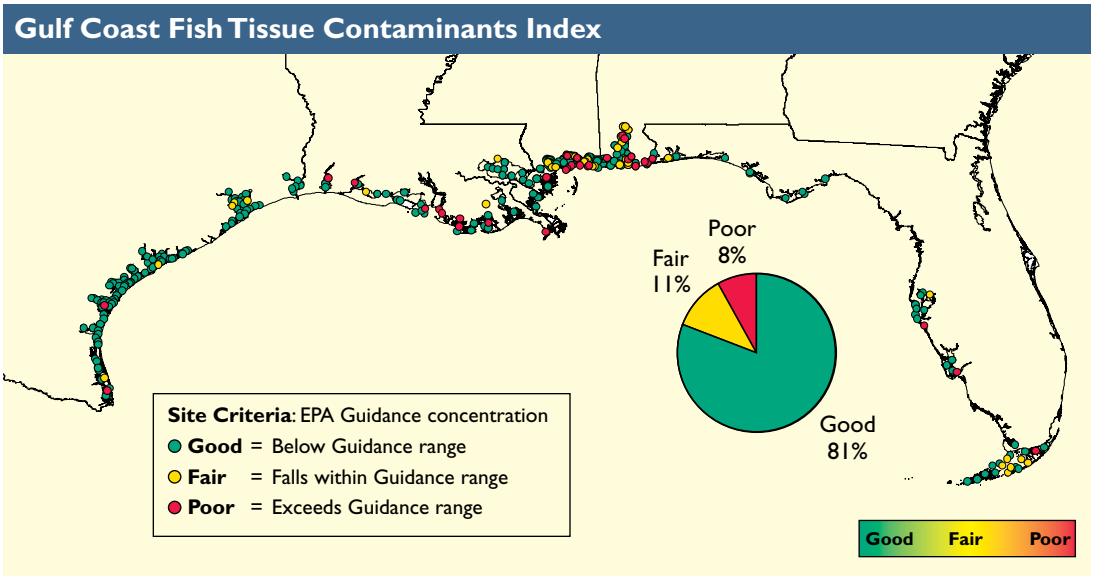


Figure 5-9. Fish tissue contaminants index data for Gulf Coast coastal waters (U.S. EPA/NCA).

Highlight

Project GreenShores Shoreline Restoration Project

The shoreline along Bayfront Parkway on Pensacola Bay in Florida has been subjected to pressures from human activities since as early as the 19th century. At that time, this portion of the bay was filled with wharfs and teeming with ships transporting timber cut from the forests of northwest Florida. Much of the bayfront and adjacent marsh areas were filled in, and the shorelines were hardened. In fact, privately and city-owned plots with streets are delineated into the bay. As is the case in many historic coastal communities, stormwater treatment is lacking in this older part of town, with stormwater directly entering the bay.

Although the shoreline has been significantly altered over time, the project area supported some SAV until the 1950s (Gulf of Mexico Foundation, 2007); therefore, there seemed to be enormous potential for a successful habitat restoration and enhancement project that would increase public awareness of the native species and habitats within the Pensacola Bay System. Project GreenShores Sites 1 and 2 focus on the highly visible area of Bayfront Parkway (at the north end of the Pensacola Bay Bridge) as the stage for a large-scale multi-habitat restoration project. Approximately 15 acres of subtidal and intertidal zones at Site 1 have been restored with oyster reefs, SAV, and emergent vegetation (Gulf of Mexico Foundation, 2007). As of August 2005, Site 2 had been designed and partially funded, and the project had entered the final permitting stages. Site 2 will continue the shoreline restoration project to the west along Bayfront Parkway and will add an additional 38 acres of emergent vegetation, oyster reefs, tidal channels, and SAV.

Project Greenshores, Site 1 (courtesy of Amy Baldwin, Florida Department of Environmental Protection).

Monitoring at Site 1 has shown an expanding oyster population and an increasing abundance and diversity of fish and birds. The reef has become populated with many typical reef species, including blennies and gobies, stone crabs, blue crabs, anemones, and shrimp. Juvenile stone crabs have been observed, and oyster spat are readily apparent. Schools of baitfish, gray snapper, mullet, sheepshead, flounder, redfish, and speckled trout have all been documented around the reef and in the marsh. In addition, recreational use of the area has increased, with more fishermen, canoers/kayakers, and bird watchers taking advantage of the newly created habitat and the productivity in the area (Florida DEP, 2007).

Education has been a key focus of the restoration project. Local television and newspapers have featured the project as it has progressed, providing an opportunity to reach members of the public beyond the thousands who drive by it every day. A grant-funded educational cruise aboard the *American Star* has hosted more than 4,000 students and civic group members. These cruises provide participants with a visit to the site, an opportunity to "seed-the-reef" with oyster shell, and worksheets for teachers to use as follow-up lessons to reinforce the learning experience.

A unique component of this habitat restoration project has been the community partnership support that has developed as the project progressed. More than 60 partners have contributed to the Project GreenShores restoration effort, including local businesses, state and local government, federal/state/local granting organizations, citizen groups, and individuals (Florida DEP, 2007). Contributions have ranged from volunteer time and expertise, to no- or low-cost supplies and equipment, to financial support. These cooperative and volunteer activities have resulted in a project that has provided many members of the community with a sense of ownership in Project GreenShores and are a focal point for teaching students and community members about environmental issues.

The American oystercatcher (*Haematopus palliatus*) is one of the more than 65 species of birds that have been spotted at Project Greenshores, Site I (courtesy of Kevin T. Edwards, IAN Network).